Space Weather Technical Forecast

Issued on Thursday, 08 September 2022 at 13:08 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Active electron fluence Likely throughout. Now-reduced Slight Chance of further G1/Minor Geomagnetic Storms at first.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low over the past 24 hours, with X-ray activity at GOES16 generally residing in high B-class, with occasional small C-class flares observed. The largest of these flares was a C1.3 observed at 08/0937UTC, which appeared to emanate from an as yet unnumbered sunspot group in the northeastern quadrant. This was one of up to six sunspot regions on the solar disc at present. The most noteworthy of these in terms of its complexity on paper is AR3096 in the northeastern quadrant, which currently manifests as a Beta/Dai group, with slight growth in its trailing spot and minor proliferation of its intermediate regions. Also of note were the flaring unnumbered region which grew from a diffuse Bxo to perhaps reach Cri/Beta by the period's end. The other regions on the disc all showed stable or decaying trends and were unproductive.

An apparently minor disappearing filament was observed from the south-central disc shortly before the 24-hour period began - at around 07/1100UTC. There is not currently any triangulating STEREO A COR2 imagery available, but ejecta seen in subsequent Lasco imagery appears to suggest a weak and slow Coronal Mass Ejection (CME) heading largely below the ecliptic plane. This will be confirmed or adjusted in coming guidance.

No other potentially Earth-directed CMEs were in evidence.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, was indicative of a slowly waning coronal hole HSS from CH20/+. Wind speeds remained Elevated, with an erratic trace perhaps best described as falling from values near 600km/s to 500 in the period. Density was mostly average in high single-figures ppcc. Total interplanetary magnetic field strength, Bt, was weak at 7nT or below. The north-south component, Bz, varied between +6 and -5nT, but crucially spending protracted periods either co or anti-aligned with Earth's field to lesser or greater effect respectively. As required for connection to CH20/+, the phi angle was largely positive (away from the Sun) throughout.

The net result of the above geomagnetic activity was provisionally mainly Unsettled, with Kp peaking at Minor Storm G1 (Kp 5-) in the 06-09UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16, was at Background levels.

The high energy electron flux (greater than 2 MeV) was at High levels, with a peak of 15,400 pfu at 07/1740 UTC. The 24-hour integrated electron fluence remained above the Active (1e8 integrated pfu) threshold on a rising trend, with 5.71e8 integrated pfu observed at 08/0001UTC.

Four-Day Space Weather Forecast Summary

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Met Office Space Weather Technical Forecast

Solar Activity: Solar activity is expected to be largely Low, with a Slight Chance of becoming Moderate with isolated M-class flares, most likely from AR3096.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently in the forecast.

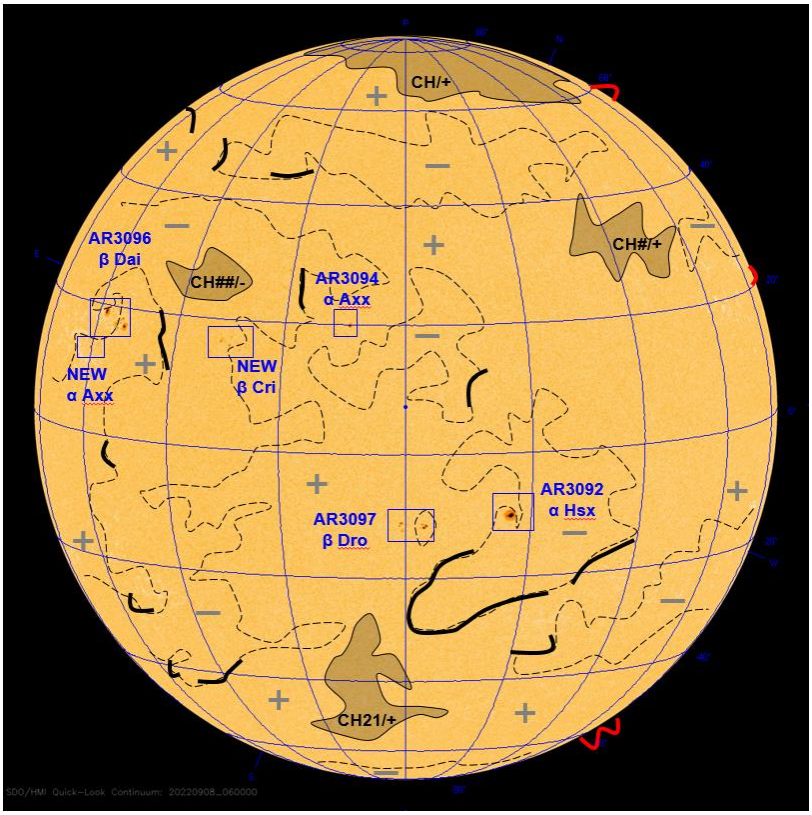
Solar winds continue to be elevated from the waning effects of CH20/+. Wind speeds are expected to ease somewhat over the coming days, however a weaker HSS from an unnumbered faint coronal hole in the northwest may give a continuation of elevated, likely easing to slightly elevated, wind speeds through this period. Confidence in this is lower than average.

Geomagnetic activity will likely be Quiet to Active, with a slight chance of G1/Minor Storm intervals on Day 1 (08 Sep). This should slowly ease through the period to become largely Quiet to Unsettled by Day 3 (10 Sep).

Energetic Particles / Solar Radiation: High energy protons (greater than 10 MeV) are expected to remain below S1/Minor radiation storm levels.

The high energy (greater than 2 MeV) electron flux is currently at High levels and are likely to remain High for much of this period. The corresponding 24-hour fluence is likely to remain above the Active (1e8 integrated pfu) threshold through much of this period. A declining trend is most likely, although as mentioned above a further rise cannot be ruled out, with just a Slight Chance of reaching Very Active (1e9 integrated pfu).

Figure 1. Solar Analysis Valid 08/0600UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Geomagnetic Storms:

No Earth-directed CMEs are currently expected. There is evidence in Lasco imagery of a southward-heading CME in the past 24 hours. Cursory analysis using Lasco's viewpoint only (i.e. no triangulation or corroboration from STEREO A) suggests that the feature may miss to the south, however this will be looked at in the coming hours and confirmed or adjusted accordingly. No other events were in evidence, and the above possible candidate does not currently feature in the forecast risk percentages above.

Solar winds continue to be elevated from the waning effects of CH20/+. Wind speeds are expected to ease somewhat over the coming days, however a weaker HSS from a faint coronal hole in the northwest (evident on SDO AIA-211 imagery but not 193) may follow on from CH20. This feature may give a continuation of elevated, likely easing to slightly elevated, wind speeds through this period. Confidence on this element of the forecast is lower than average. Either way, both are positive coronal holes with the risk of a slightly more enhanced geomagnetic response at this time of year.

Geomagnetic activity will likely be Quiet to Active, with a slight chance of G1/Minor Storm intervals on Day 1 (08 Sep). This should slowly ease through the period to become largely Quiet to Unsettled by Day 3 (10 Sep).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	20	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Radio Blackouts - X-Ray Flares:

There are currently up to six sunspots on the visible disc, including an unnumbered region in the northeast that produced the largest flare of the period, perhaps reaching Cri/Beta classification before stalling.

Solar activity is expected to be largely Low, with a Slight Chance of becoming Moderate with isolated M-class flares. The largest spot on the disc remains AR3096 (Dai/Beta) which has grown in the last 24 hours, however it is still magnetically simple and unproductive in terms of flares. AR3097 (Dro/Beta) has also shown some minor growth but is also magnetically simple. All other regions are currently small and simple.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) remains at background values.

The location and lack of complexity of all current sunspots on the visible disc suggest high energy protons (greater than 10 MeV) are expected to remain below S1/Minor radiation storm levels.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	2	2
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):

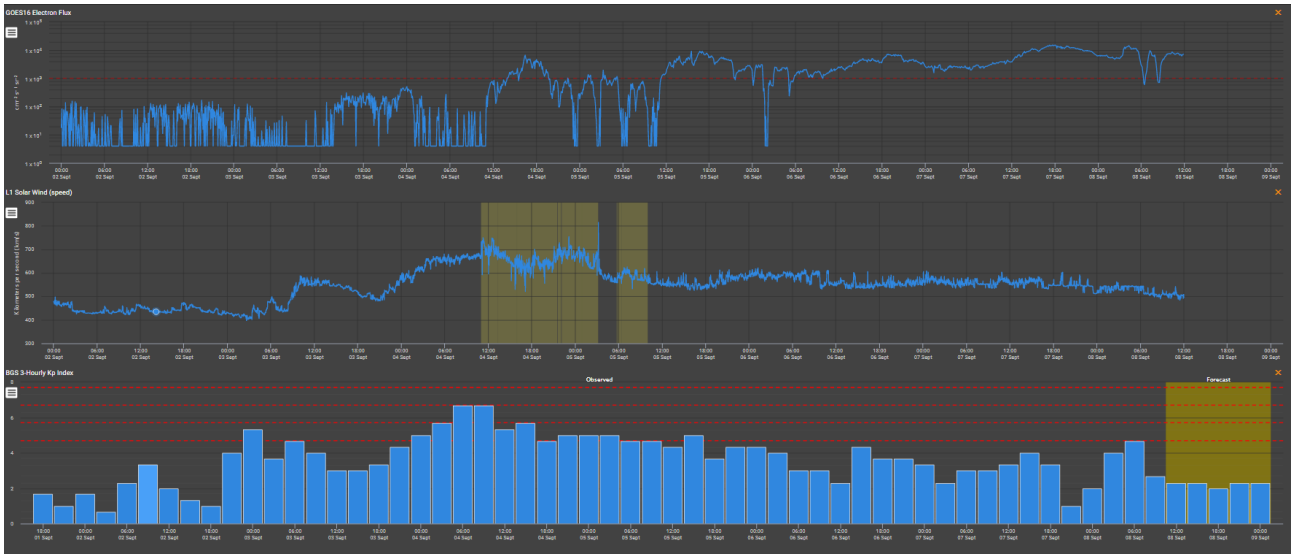
The high energy (greater than 2 MeV) electron flux is currently at High levels due to charging from the HSS from CH20. Flux levels are likely to remain High for much of this period, perhaps on a declining trend. However, as wind speeds are still elevated perhaps causing some compression of the Van Allen belt, a further rise cannot be ruled out as the radiation belt fully decompresses.

The corresponding 24-hour fluence is likely to remain above the Active (1e8 integrated pfu) threshold through much of this period, which is supported by persistence. A declining trend is most likely, although as mentioned above a further rise cannot be ruled out, with just a slight chance of reaching Very Active (1e9 integrated pfu).

REFM is thought to give good guidance, showing a slight declining trend above the Active threshold.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	90	80	60
Very Active	≥ 2 MeV ≥ $1x10^9$	No	20	20	10	5

Figure 2: The past week in GOES16 electrons (top), showing an increasing amplitude diurnal response to (middle) the L1 ACE and DSCOVR-recorded soalr wind speed. Also shown (below) is BGS 3-hourly Kp observations (forecast in yellow). It is felt that current electron flux levels should be near their peak, most likely turning from Very Active and very gradually ebbing in the increasingly less supportive solar wind environment that should characterise the coming UTC weekend.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.